MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

TCS 2241 – COMPUTATIONAL SCIENCE

(All sections / Groups)

7 MARCH 2019
9:00 a.m – 11:00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 5 pages (excluding cover page) with 5 Questions and Appendix of statistical table.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided

Question 1

(a) Harapan Auto manufactures luxury cars and trucks. The company believes that its most likely customers are high income men and women. To reach these groups, Harapan Auto has embarked on an ambitious TV advertising campaign and has decided to purchase 1-minute commercial spots on two types of programs: comedy shows and football games. Each comedy commercial is seen by 7 million high-income women and 2 million high-income men. Each football commercial is seen by 2 million high - income women and 12 million high-income men. A 1-minute comedy ad costs RM50,000, and a 1-minute football ad costs RM100,000. Harapan Auto would like the commercials to be seen by at least 28 million high-income women and 24 million high-income men. Decide how Harapan Auto can meet its advertising requirement at its minimum cost. Formulate a Linear Programming model for this problem. Define the decision variables, objective function and all the constraints that fulfill this problem.

[2.5 marks]

(b) There are 3 types of special cases in Linear Programming (LP), which are

Case 1: having alternative or multiple optimal solutions.
Case 2: having infeasible solutions.
Case 3: having unbounded solutions.

Identify which case applies to the following final iteration of the simplex table for a **maximization** problem and explain on why you are not able to continue the next iteration.

[2 marks]

Basic Variable	**Coefficient of**							
	Z	**X_1**	**X_2**	**X_3**	**X_4**	**S_1**	**S_2**	**Solution**
Z	1	0	2	-9	0	12	4	100
S_1	0	0	1	-6	1	6	-1	20
S_2	0	1	1	-1	0	1	0	50

(c) Given first iteration table for a **maximization** problem using Big-M method. Continue the remaining iterations until you get the optimum solution for Z, X_1, X_2 and X_3.

[5.5 marks]

Basic Variable	**Coefficient of**								
	Z	**X_1**	**X_2**	**X_3**	**S_1**	**S_2**	**S_3**	***A***	**Solution**
Z	1	-2M+4	-M+4	-3M+1	0	0	M	0	-3M
S_1	0	1	1	1	1	0	0	0	2
S_2	0	2	1	0	0	1	0	0	3
A	0	2	1	3	0	0	-1	1	3

Continued .....

Question 2

The following Linear Programming (LP) problem is **having multiple solutions**.

Maximize $Z = 3x_1 + 2x_2$
subject to
$3x_1 + 2x_2 \leq 120$
$x_1 + x_2 \leq 50$
$x_1, x_2 \geq 0$

(a) Use graphical method to sketch the objective function and constraints. Highlight the feasible region. [3 marks]

(b) Give TWO (2) optimal solutions of the LP problem. [2 marks]

(c) To solve LP problem using simplex method, convert the problem into the standard format. [2 marks]

(d) Create the initial simplex table based on (c). [3 marks]

Question 3

(a) The daily demand for vanilla ice cream at the Daily Scoop has a normal distribution with a mean of 80 liters and a standard deviation of 10 liters. The store's inventory policy calls for ordering 800 liters whenever the inventory level drops to 440 liters. Assuming a constant effective lead time of 5 days, find the probability of running out of stock during lead time.

[5 marks]

(b) In the aspect of non-linear programming problem, Karush-Kuhn-Tucker (KKT) method is suitable for inequality ($\leq$, $\geq$) constraint. Given the following KKT conditions for a maximization problem, find the optimal solution.

[5 marks]

$$\frac{\partial f}{\partial x_j} - \lambda \frac{\partial h}{\partial x_j} = 0$$

$$\lambda h(x) = 0$$

$$h(x) \leq 0$$

$$\lambda \geq 0$$

$$f = -5x_1^2 - 7x_2^2 + 15x_1 + 20x_2 + 7$$

$$h(x_1, x_2) = 4x_1 + 2x_2 - 3$$

Continued .....

Question 4

(a) A company supplies goods to three customers, who require 30 units each. The company has two warehouses. Warehouse 1 has 40 units available, and warehouse 2 has 30 units available. The costs of shipping 1 unit from warehouse to customer are shown in table below. There is a penalty for each unmet customer: with customer 1, a penalty cost of RM90 is incurred; with customer 2, RM80, and with customer 3, RM110.

	To		
From	Customer 1	Customer 2	Customer 3
Warehouse 1	RM15	RM35	RM25
Warehouse 2	RM10	RM50	RM40

(i) Formulate a balanced transportation problem to minimize the sum of shortage and shipping costs.

(ii) Use the Northwest Corner method to find the initial cost.

[1 + 2 = 3 marks]

(b) The following table is part of the iteration in solving a transportation problem, where the non-basic variables are indicated with brackets (). If this iteration table is not optimal, draw the next iteration table.

[4 marks]

	v_1=15	v_2=35	v_2=25	
u_1 =0	15 **30**	35 **10**	25 (0)	40
u_2 =15	10 (20)	50 **20-θ**	40 **10+θ**	30
u_3 =85	90 (10)	80 **θ** (40)	110 **20-θ**	20
	30	30	30	

(c) Given one of the iteration of the Hungarian method to minimize the total time required to perform the 4 jobs with 4 workers. Explain on how you determine this iteration table achieves the optimal solution. If it is not optimal, continue the remaining iterations until you get the optimal solution. [3 marks]

Workers	**Job 1**	**Job 2**	**Job 3**	**Job 4**
Abu	0	10	0	0
Ah Seng	220	10	0	30
Maju	60	20	0	40
Peter	70	0	0	0

Continued .....

Question 5

(a) Telco Malaysia is currently developing a new 4G project in Melaka. The following table provides the ten associated activities with its respective duration time (in months) involved in the 4G project.

Activity	Description	Predecessor(s)	Duration (days)
A	Find site	-	16.5
B	Find engineers	A	17.5
C	Plan the network design	A	18.5
D	Estimate budget	B	16
E	Carry out the plan	B, C	20.33
F	Monitor the progress	B	23.33
G	Network testing	D, E	8.5
H	Set up coverage	F, G	23
I	Evaluate the coverage	B, C	25
J	Last-minute details	H, I	13

(i) Illustrate the project network diagram.
(ii) Determine the earliest and latest event times for each of the activities.

[2 + 2 = 4 marks]

(b) Dijkstra's and Floyd's algorithm are commonly applied to solve the shortest path problem in network diagram.
(i) Explain the differences between Dijkstra's and Floyd's algorithms.
(ii) Given the starting node sequence matrix $\mathbf{S_0}$ of the Floyd's algorithm, how do you know that there is no connection path to Node 5 from all other nodes?

$\mathbf{D_0}$

	1	2	3	4	5
1	-	∞	6	3	∞
2	3	-	∞	∞	∞
3	∞	∞	-	2	∞
4	∞	1	1	-	∞
5	∞	4	∞	2	-

$\mathbf{S_0}$

	1	2	3	4	5
1	-	-	3	4	-
2	1	-	-	-	-
3	-	-	-	4	-
4	-	2	3	-	-
5	-	2	-	4	-

(iii) Use Floyd's algorithm ($d_{ik} + d_{kj} < d_{ij}$) to compute the next FOUR (4) iterations from $\mathbf{D_0}$ and $\mathbf{S_0}$ in (ii).

[1 + 1 + 4 = 6 marks]

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